Laser Therapy for Benign Pigmented Cutaneous Lesions

PIGMENTED EPIDERMAL LESIONS such as lentigines and café au lait macules present a therapeutic problem, as treatment is usually done for cosmetic benefit and may result in objectionable hypopigmentation, hyperpigmentation, epidermal atrophy, or scarring. Dermal pigmentation such as melasma, a nevus of Ota, blue nevi, and tattoos cannot be removed without scarring using current therapies.

Because of these problems, removal of these lesions with the use of lasers has been a consideration. The argon laser (wavelength 488 nm and 514 nm) is appropriate when melanin is the target, but its continuous output results in the delivery of too much thermal damage to the epidermis to be useful as selective therapy for pigmented lesions. This excessive energy causes heat damage and resultant slow wound healing with the potential of scarring.

The next laser to be used in the treatment of pigmented lesions was the carbon dioxide laser (wavelength 10,600 nm). Although this laser is not specific for pigment absorption (its target is any water-containing tissue), its advantage has been its extreme precision, especially when used in a superpulsed mode (a feature that minimizes unwanted thermal damage) and with low-energy fluences. Used within these boundaries, the carbon dioxide laser has proved to be an improvement over the existing methods. The use of the carbon dioxide laser in this manner, however, requires skill and experience; it cannot be used for dermal lesions without scarring. The same adverse reactions as with the argon laser may occur in the treatment of epidermal pigmented lesions, but the skillful use of this instrument in appropriate cases will diminish the risk.

As mentioned in an earlier epitome, the ruby laser (wavelength 694 nm, pulse 60 nanoseconds) has been approved for removing decorative tattoos. This laser has been remarkably successful in removing blue or black tattoo pigment and has a low risk of scarring. The laser light penetrates the dermis and interacts with the tattoo pigment granules. Some of the superficial pigment is eliminated through an epidermal crust that forms, but the deeper dermal pigment is broken down into smaller particles that can be carried away by phagocytes.* Because of its success with tattoos and the fact that its wavelength is absorbed by melanin, the ruby laser has also been used for removing both epidermal and dermal pigmented lesions, with a marked decrease in the incidence of adverse pigmentary or textural changes.

The copper vapor laser (wavelength 511 nm, pulse 20 nanoseconds) has received US Food and Drug Administration (FDA) approval for the treatment of pigmented lesions. Although its wavelength is excellent for melanin absorption, the train of 20 nanosecond pulses delivered at 10,000 to 15,000 pulses per second results in enough cumulative thermal energy to the epidermis that it is not pigment specific. This laser removes epidermal lesions by ablating the epidermis in a controlled manner and offers improvement over existing conventional nonlaser therapy.

The Candela pigment laser (wavelength 510 nm, pulse 300 nanoseconds) has received FDA approval for the treatment of pigmented lesions of the epidermis. Its wavelength is too short, however, to allow penetration into the dermis and limits treatment to epidermal lesions. This laser, as well as the ruby laser, causes selective damage of melanocytes only, sparing adjacent non–pigment-bearing keratinocytes. When a pigmented epidermal lesion is treated with this laser, abnormal melanocytes are destroyed, and, after the superficial epidermal wound heals, melanocytes from normal adjacent skin migrate to the area, resulting in normal repigmentation of the treated area.

An alexandrite laser (wavelength 755 nm, pulse 100 nanoseconds) is being tested now as a second component of this pigment laser system, designed to reach dermal pigment in the same way as the ruby laser. The pigment lasers and the ruby laser both show great potential for selectively destroying epidermal and dermal pigmented lesions without the problems of scarring and pigment alteration.

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Diagnosis of Neurofibromatosis

NEUROFIBROMATOSIS, perhaps the most serious common genodermatosis, occurs in about 1 of every 3,000 to 4,000 live births. Many different forms of neurofibromatosis have been identified. Two seem best established clinically, and their genes have been localized: neurofibromatosis 1 (classic von Recklinghausen's disease) on chromosome 17 and neurofibromatosis 2 (central or bilateral acoustic neuroma) on chromosome 22. Proof that these two variants have different genes supports the insistence that the clinical subtypes should be carefully distinguished.

The gene for neurofibromatosis 1 has not only been mapped to the long arm of chromosome 17 but also partly deciphered and cloned. It is large and complicated, and its products appear to help control the cell cycle. Neurofibromatosis 1 is characterized by a high spontaneous mutation rate: about half the patients represent a new mutation and have no family history of the disorder. For those who have two or more family members with neurofibromatosis 1, a genetic diagnosis, including prenatal diagnosis, can be reached with a high degree of accuracy using linkage analysis. Direct gene probes are being developed but are rarely applicable today.

The cutaneous examination remains a crucial and cost-effective part of the diagnosis of neurofibromatosis 1. The National Institutes of Health diagnostic criteria include three skin findings: six or more café au lait macules more than 5 mm in greatest diameter in prepubertal patients and more than 15 mm in diameter in pubertal patients; two or more neurofibromas or one plexiform neurofibroma; and axillary or inguinal freckling.

A number of cautions must be applied in using these findings. Sometimes it is simply impossible to make an accurate clinical diagnosis in an infant whose parents are unaffected. It is better to be truthful about any uncertainty than to make an error. Experience with African-American, Hispanic, and Native-American patients suggests that both café

*For more information on the ruby laser, see the epitome, "Tattoo Removal Using the Ruby Laser," page 190.